

# August 1997 Highlights of the Pulsed Power Inertial Confinement Fusion Program

We submitted a draft plan to DOE of our FY98 and FY99 activities in z-pinch physics, weapons physics, indirect drive, diagnostics, target fabrication, advanced concepts for high yield, and the National Ignition Facility. A major FY98 milestone is to obtain a 150-eV radiation temperature in a dynamic hohlraum. Discontinuation of the light ion project at the end of FY98 is reflected in the draft.

On seven shots in August we studied the behavior of a wire array striking a CD foam or carbon-based foil annulus or a solid foam cylinder inside an array. LLNL had three shots with a higher-density solid foam cylinder inside an array. Five shots were taken to complete the wire-array parameter scan at large diameters and at varying gaps between the array and the return current can.

On-axis and off-axis pinhole cameras are providing information about the initial interaction of an imploding tungsten plasma with a CD or foam target in experiments designed to demonstrate proof of principle of the dynamic hohlraum concept (see figure). In subsequent experiments, we will assess stagnation of the wire plasma on the central cylinder and shock formation in the cylinder, evolution of the radiation environment, and compression of the entire assembly. In this latter stage, the "imploding liner hohlraum" or "flying radiation case" (terms coined by SNL and LANL, respectively, in the 1980s) should produce higher radiation temperatures than are achieved with a static hohlraum.

2-D radiation, magnetohydrodynamic simulations of z pinches on Saturn and Z by LANL researchers have matched the experimental data. Before simulating the Sandia experiments, the LANL code had accurately reproduced the behavior of microsecond-scale, foil z pinches at LANL driven by high explosives on Procyon or by the pulsed-power accelerator Pegasus. The free parameter in all the simulations is a random density perturbation to represent the asymmetry that the individual wires (or the imperfect foil, in the LANL experiments) initially imposes on the implosion. Although the density perturbation is determined by finding the level that generates the observed data, it reproduces important features of the Sandia experiments: the current drive, radiation pulse shape, maximum radiated power, and total radiated energy. Recent LANL simulations of Z experiments show the development of a short-wavelength instability that saturates without causing the plasma shell to disrupt completely, followed by the development of a longer-wavelength instability. These effects, which result in a thickened plasma shell, may be responsible for the shell remaining intact and the subsequent high quality of the implosion.

Sandia is the only laboratory with a three-stage gas gun. In FY98, pending funding approval, we will use this system to obtain equation of state (EOS) data for cryogenic D<sub>2</sub> to about 600 kbars for comparison with and validation of data from z-pinch implosions. The ultimate objective is to obtain EOS data with z pinches at pressures that will reduce the extrapolation that is now required to assess weapons components and weapons physics performance in the absence of underground tests. The z-pinch part of the effort will begin by determining shock Hugoniot of plastic and beryllium.

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